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Ohmura

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(54) **CHARGING CONNECTOR**

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(30) **Foreign Application Priority Data**

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(51) **Int. Cl.**
H01R 13/627 (2006.01)

(52) **U.S. Cl.**
CPC ***H01R 13/6275*** (2013.01)

(58) **Field of Classification Search**
CPC H01R 13/6275; H01R 13/6273; H01R 13/641
USPC 439/352, 372
See application file for complete search history.

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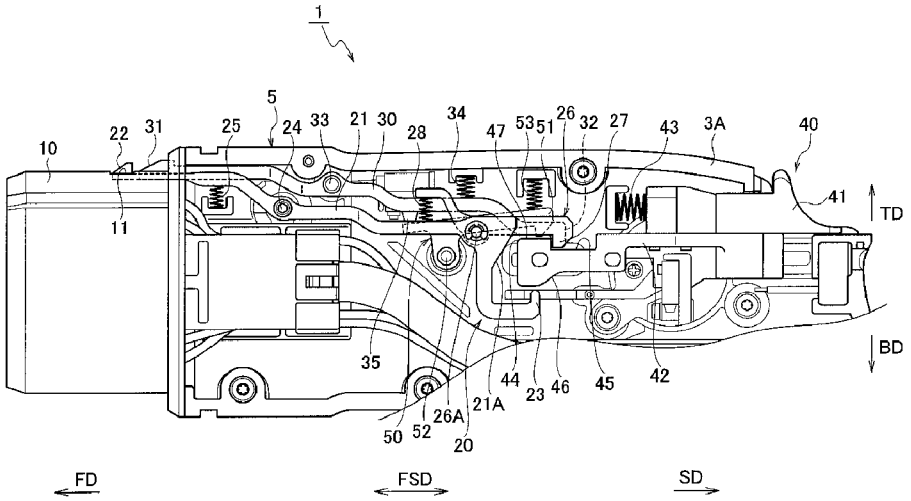
(57) **ABSTRACT**

In the charging connector, in a movement process of a release lever from a start position to a completion position, a holding locking piece moves on a plane surface of the release lever with an urging force of a coil spring, and also an auxiliary locking piece slides over a top point between the plane surface and an inclined surface with an urging force of a coil spring. At the completion position of the release lever, the holding locking piece falls from the plane surface of the release lever to an upper-side locking groove portion with the urging force of the coil spring to be locked on a locking surface, and thus a tip end of the holding locking piece does not come into contact with a bottom surface.

3 Claims, 14 Drawing Sheets



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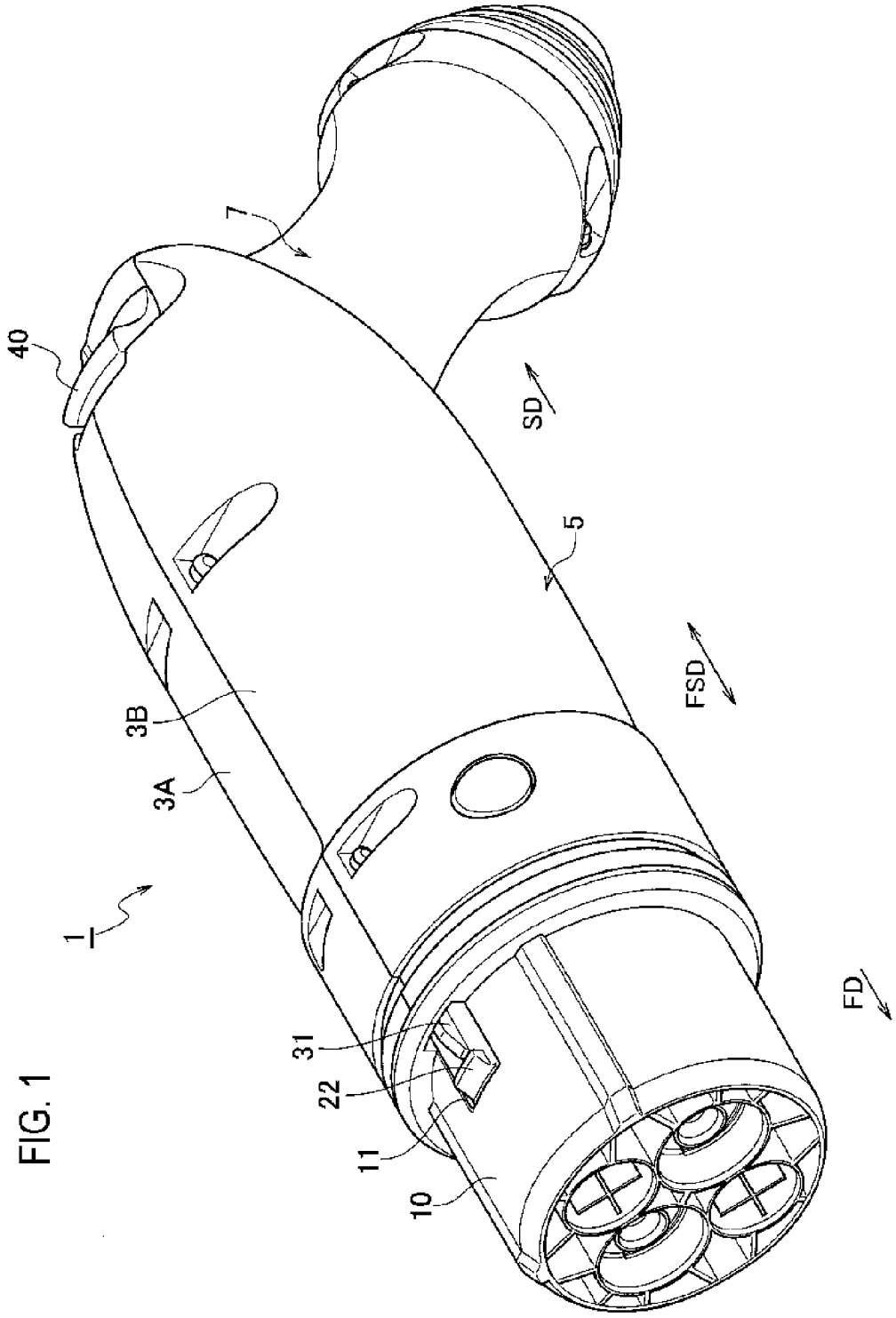

FIG. 1

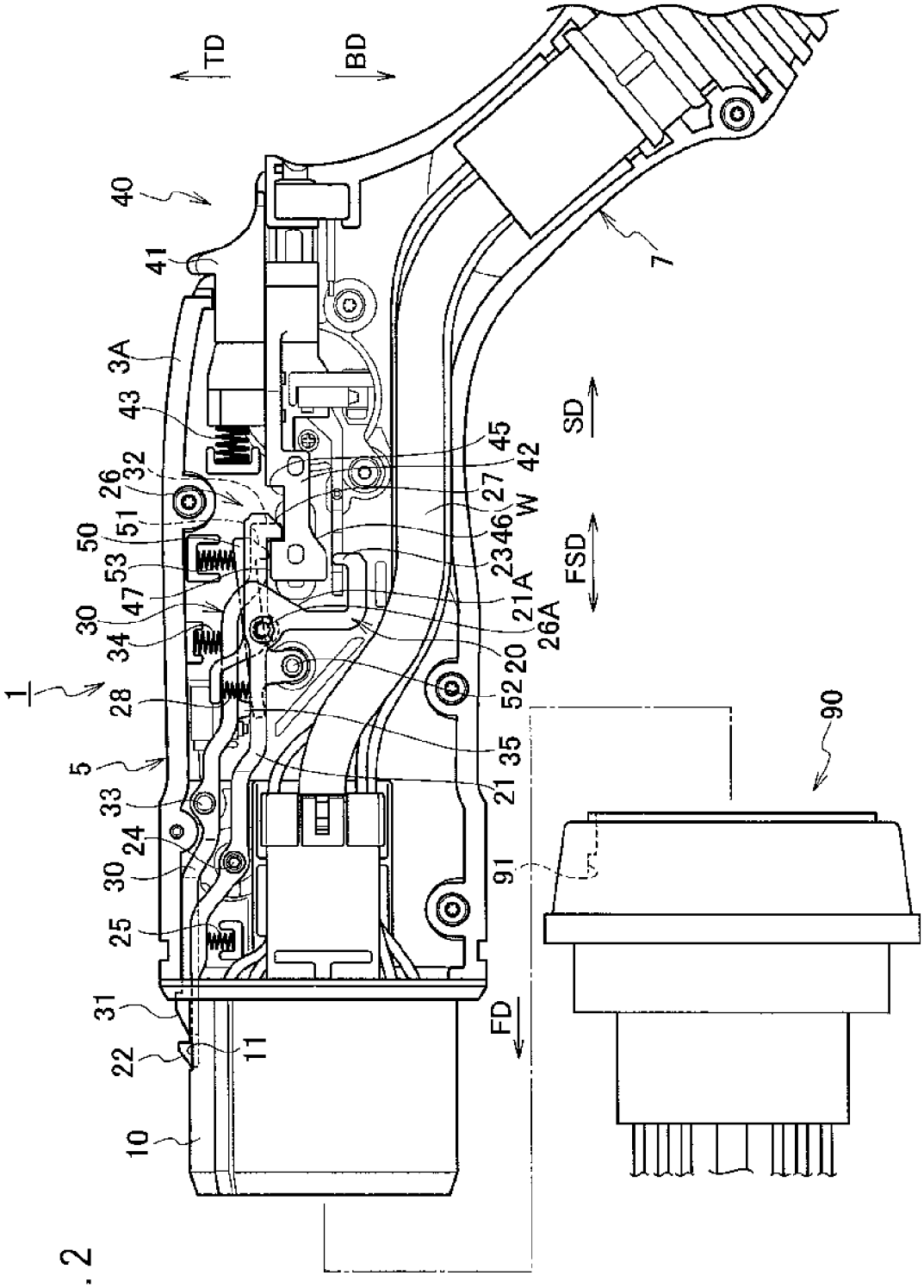
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FIG. 2

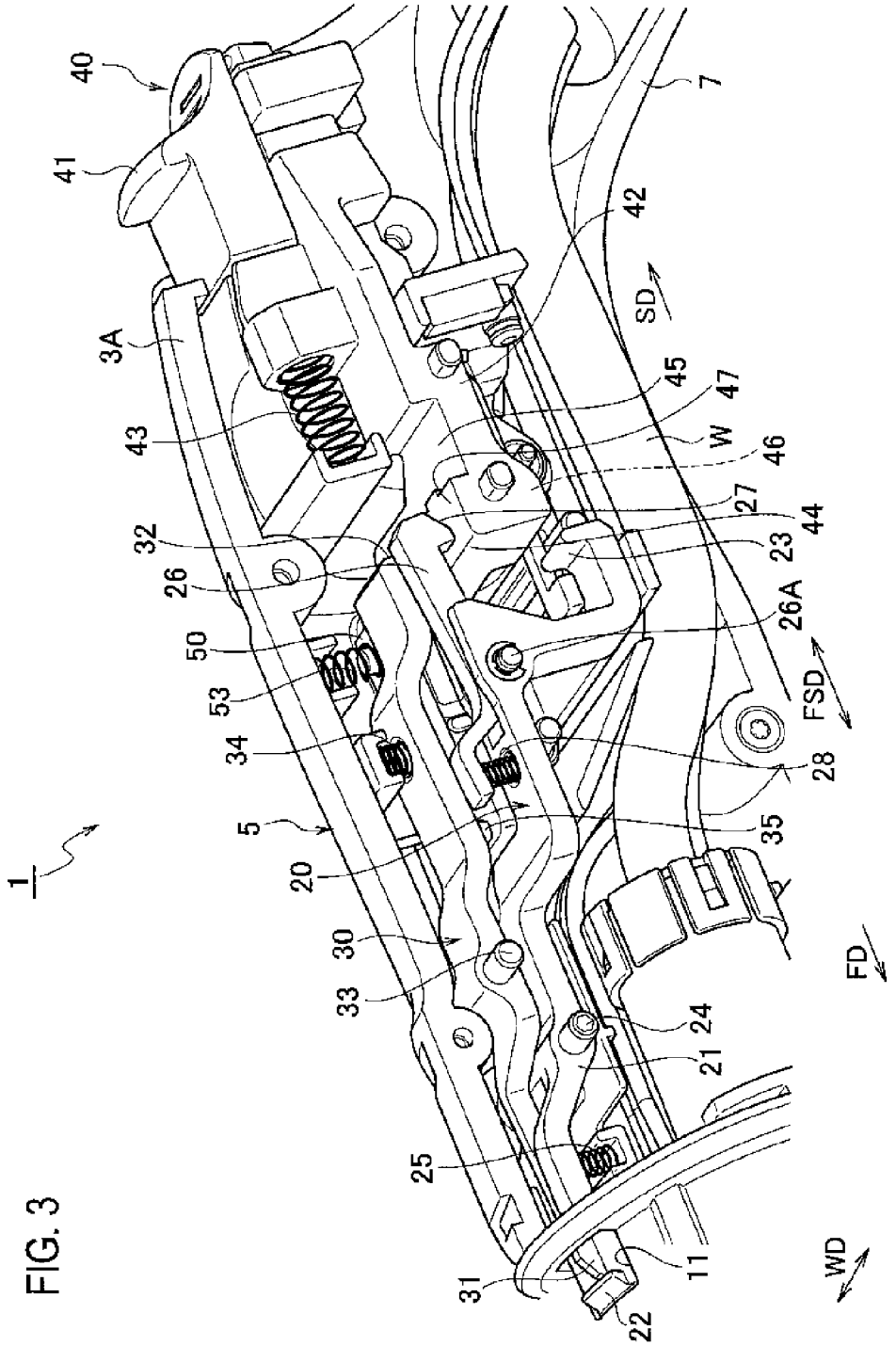
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FIG. 3

FIG. 4

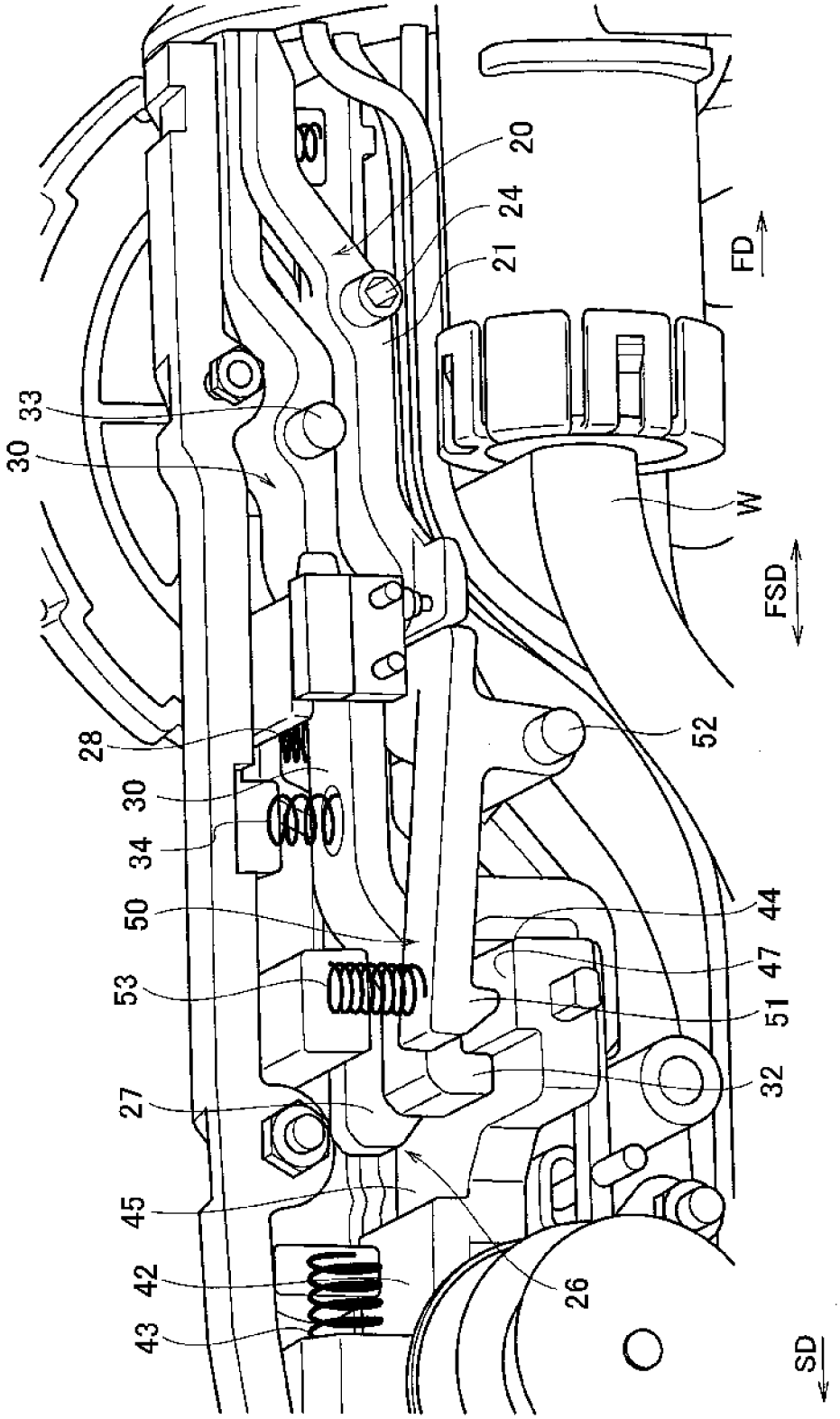

FIG. 5

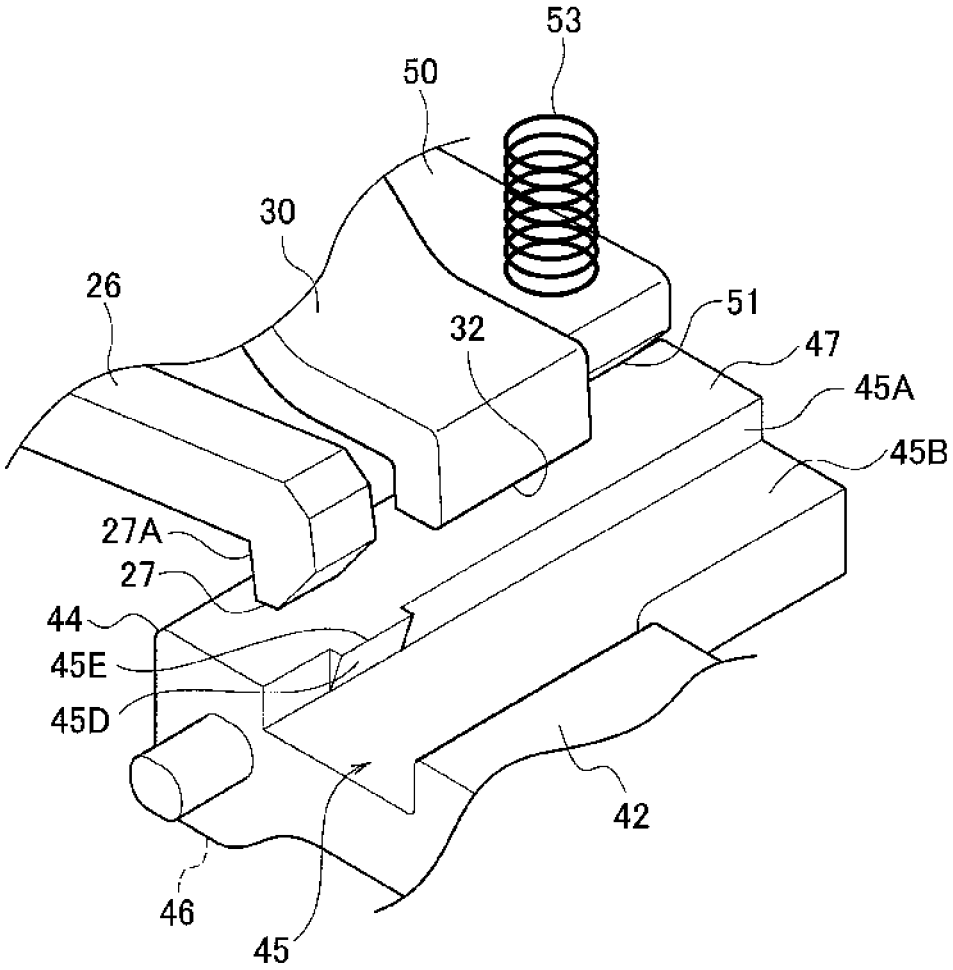

FIG. 6

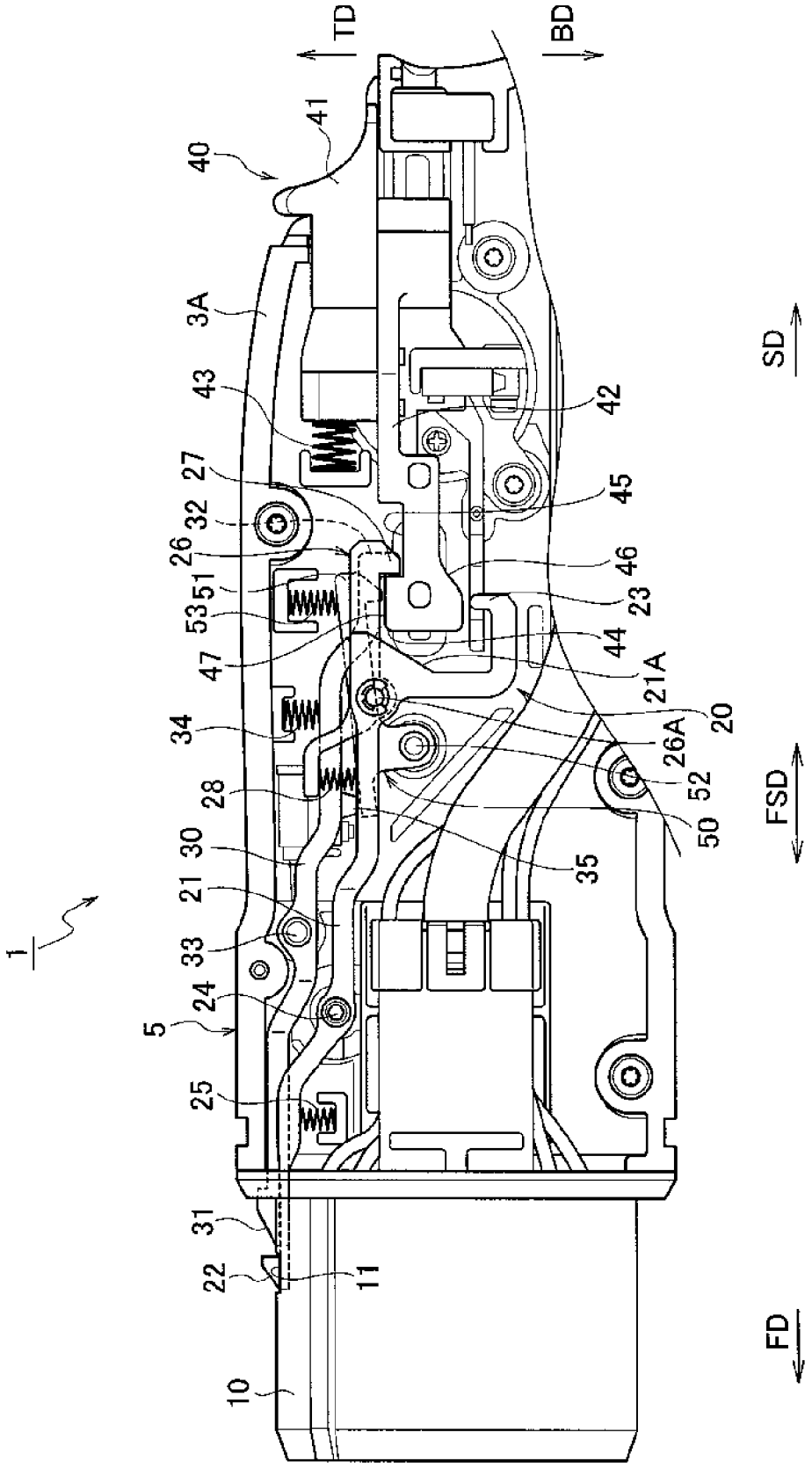
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FIG. 7

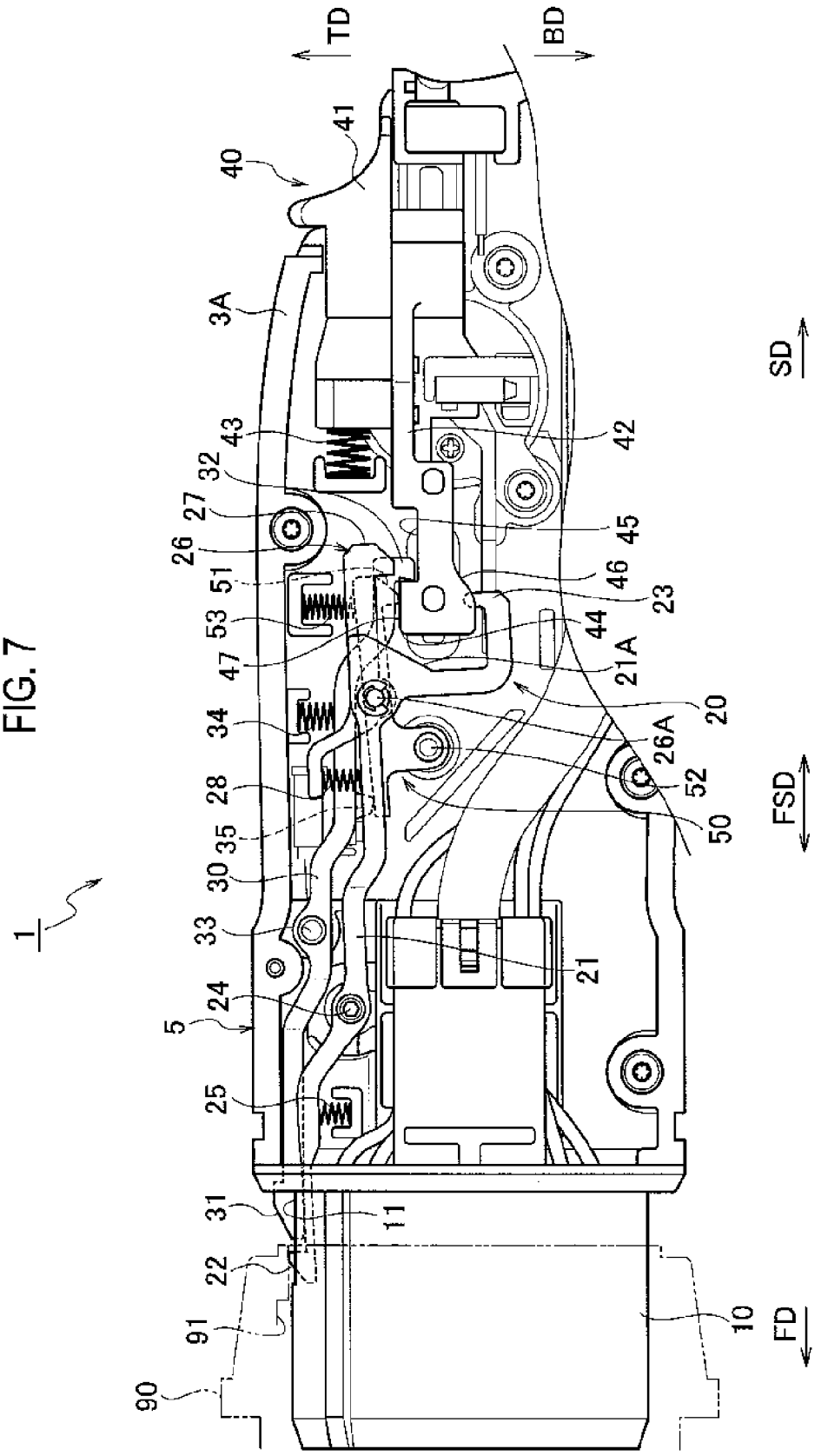
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FIG. 8

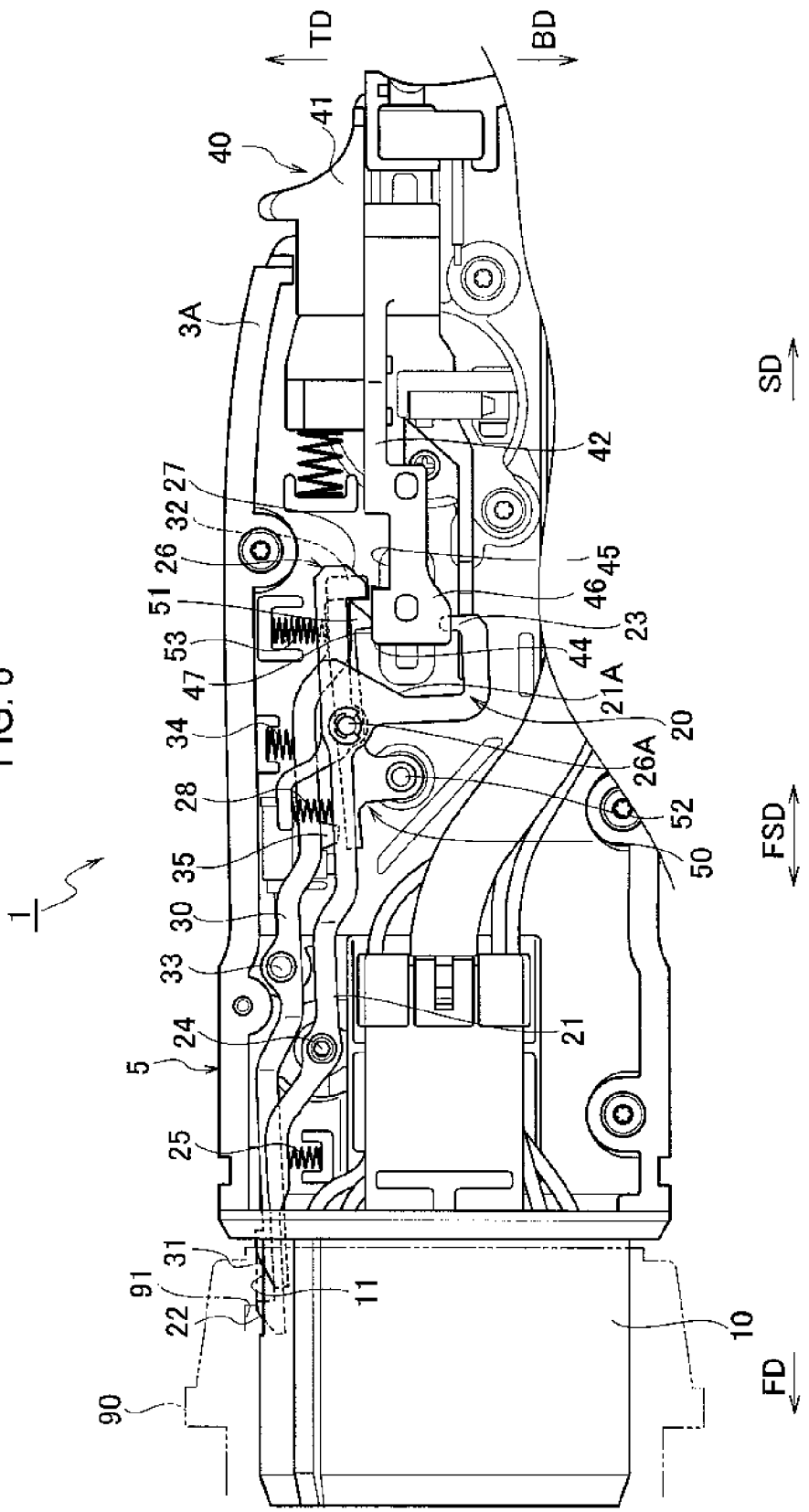
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FIG. 9

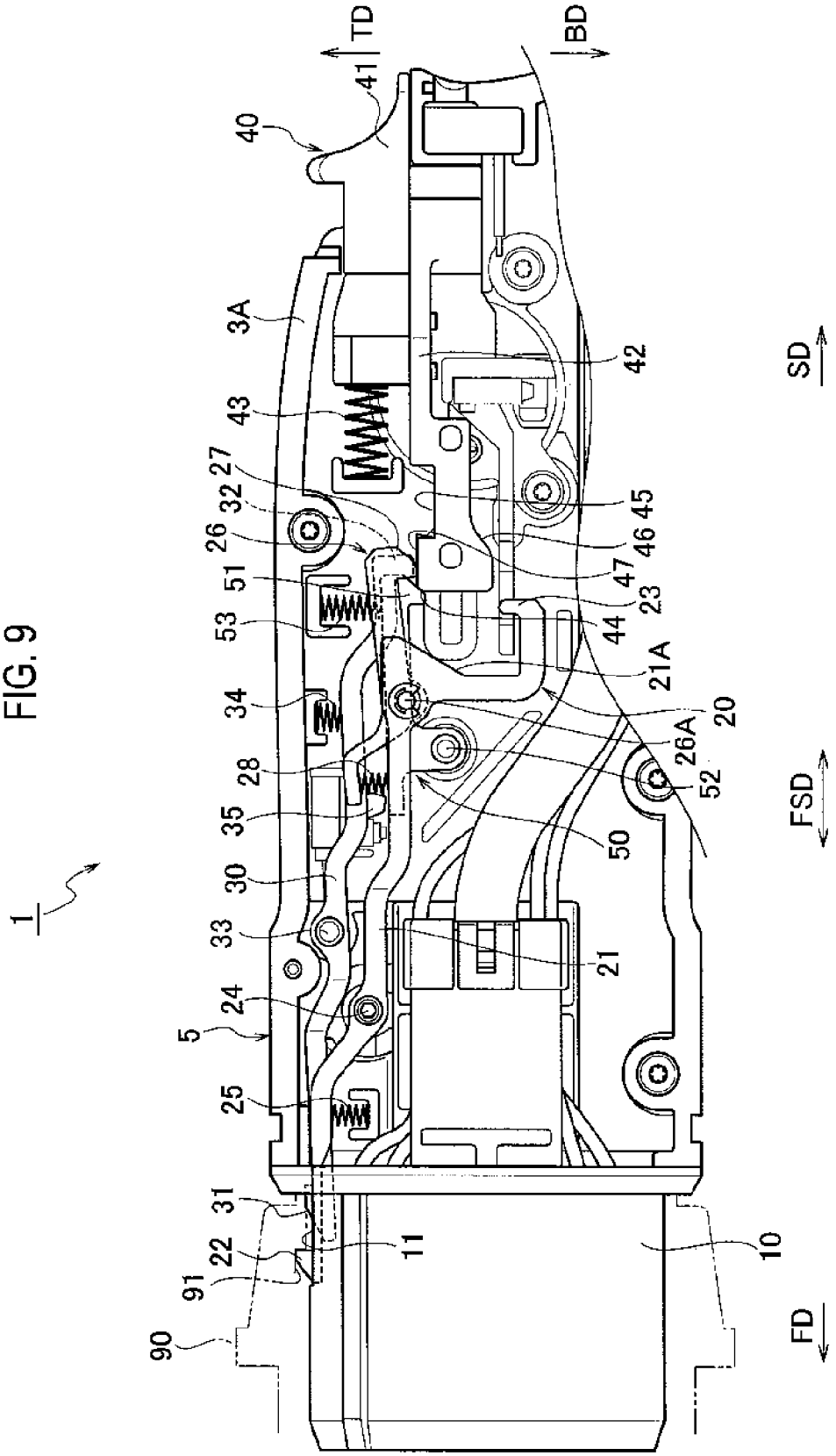
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FIG. 10A

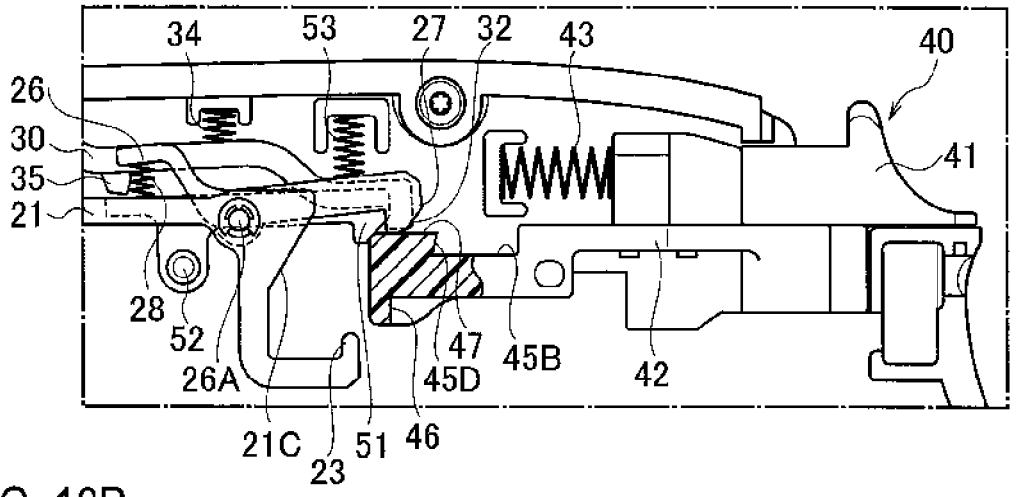

FIG. 10B

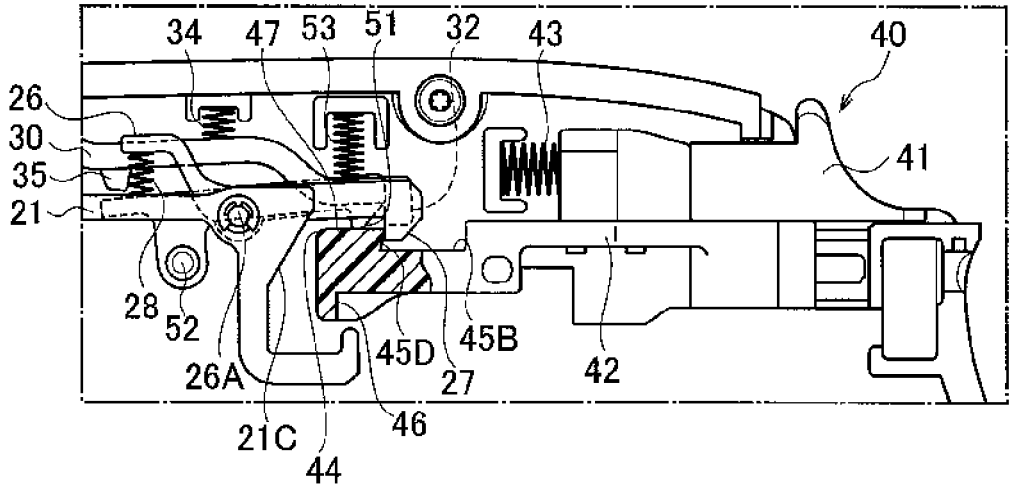

FIG. 10C

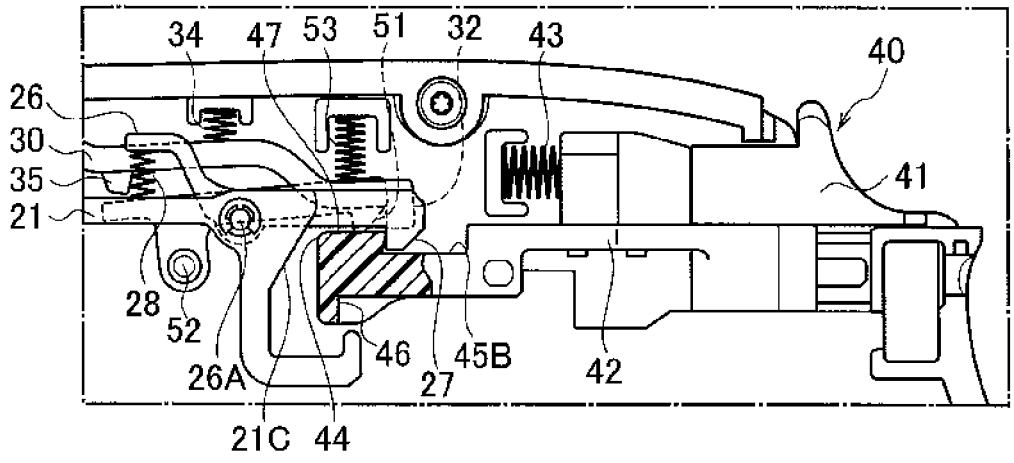

FIG. 11A

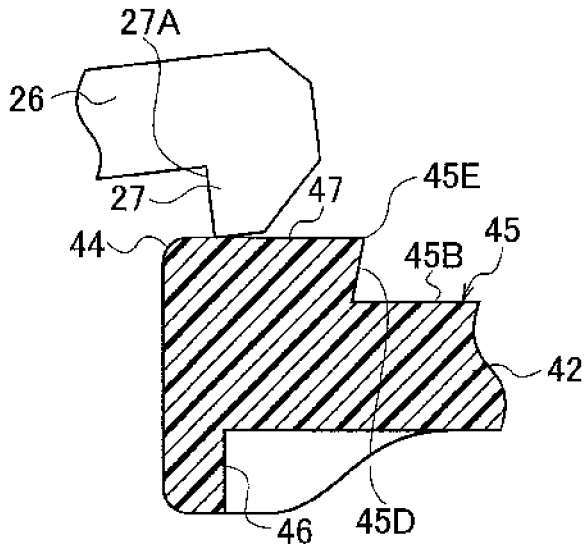

FIG. 11B

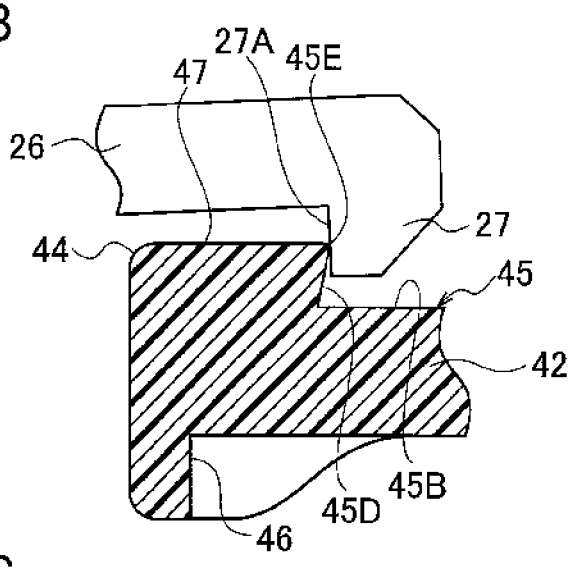

FIG. 11C

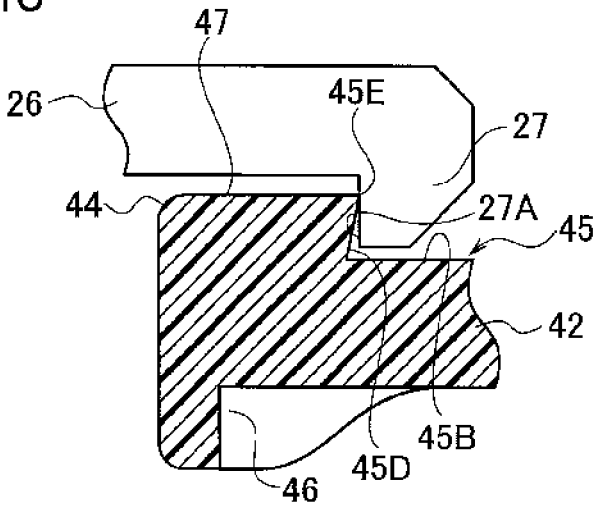

FIG. 12

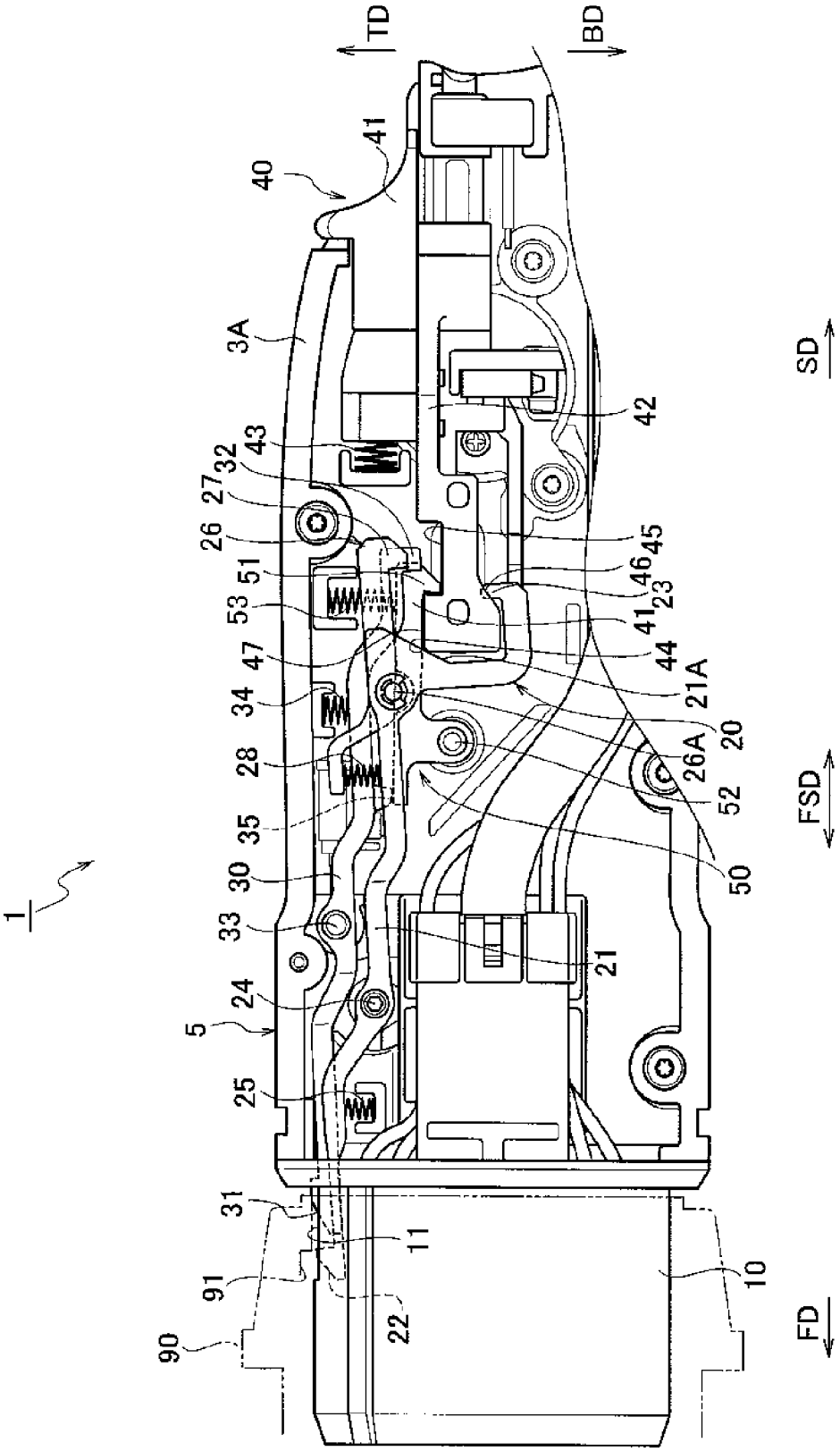
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FIG. 13

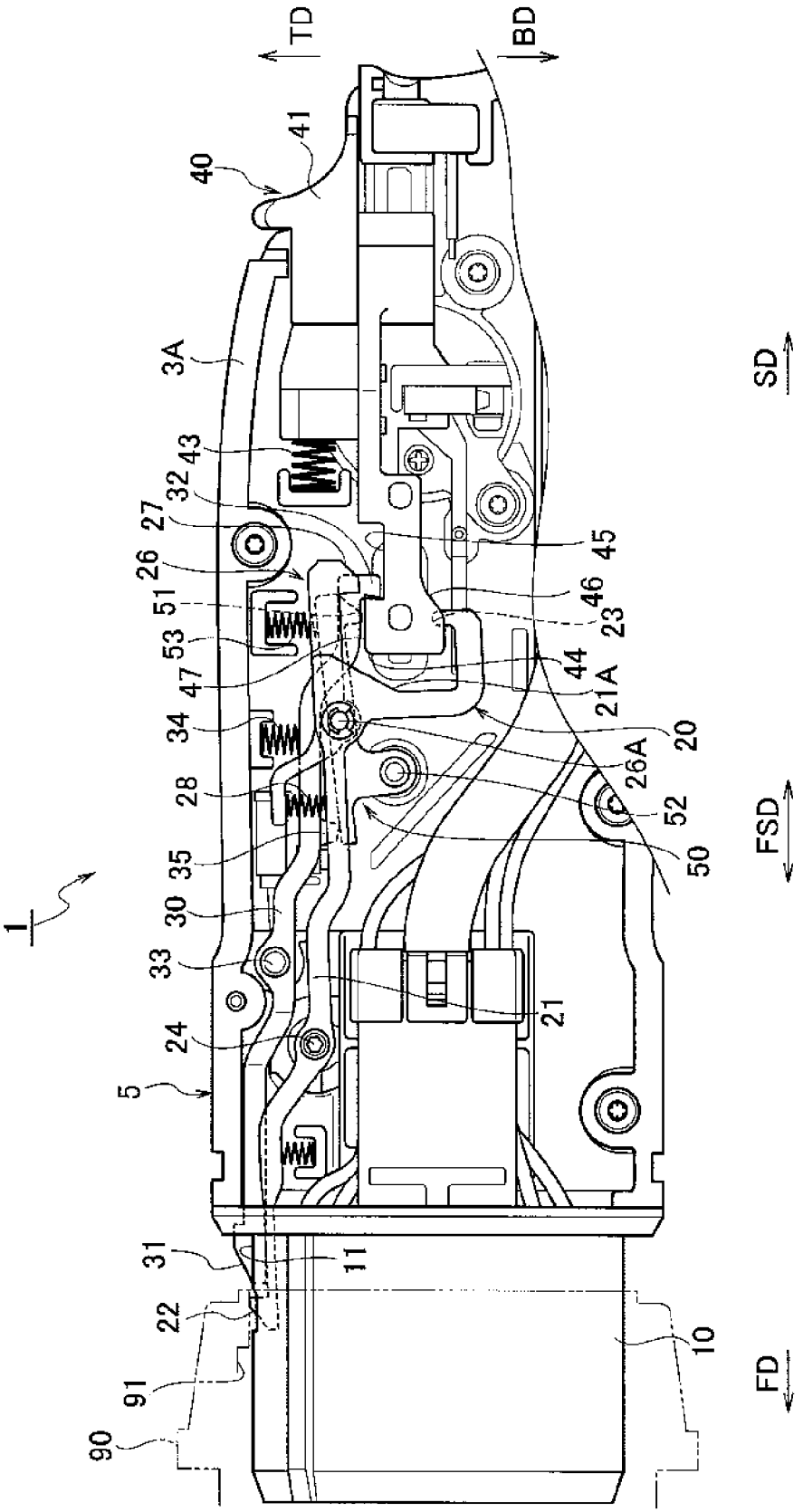
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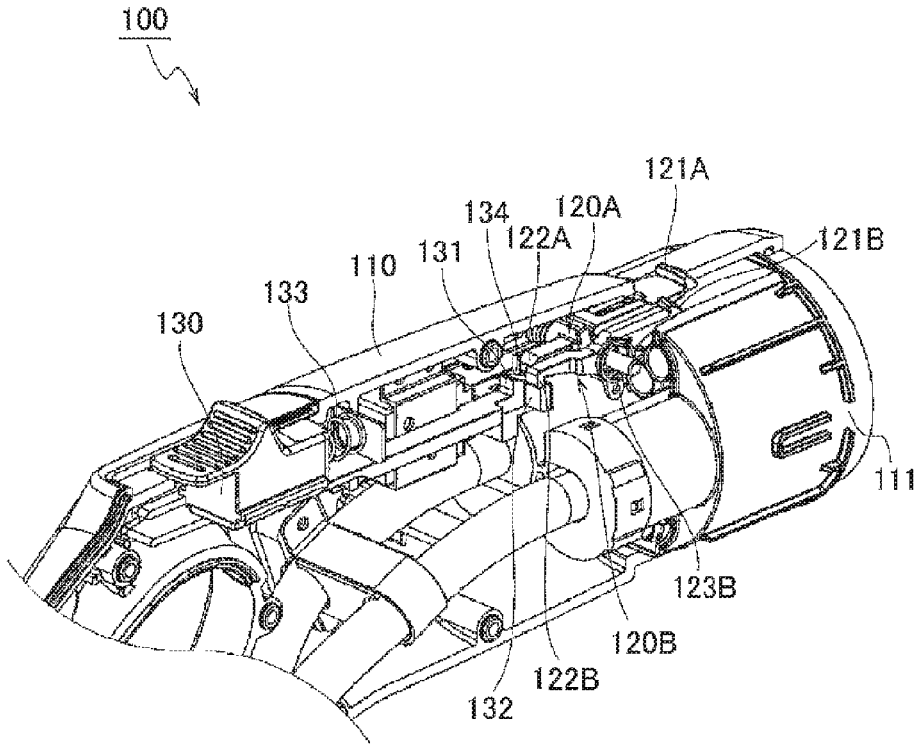
FIG. 14
PRIOR ART



CHARGING CONNECTOR

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation application of International Application No. PCT/JP2014/060136, filed on Apr. 8, 2014, which claims priority to Japanese Patent Application No. 2013-080094, filed on Apr. 8, 2013, the entire contents of which are incorporated by reference herein.

BACKGROUND

1. Technical Field

The present invention relates to a charging connector and, particularly, to a charging connecter to be fitted into a vehicle-side inlet provided in a vehicle.

2. Description of the Related Art

In recent years, due to improvement of environmental consciousness, an electric vehicle (e.g., electric vehicle (EV) and a hybrid electric vehicle (HEV)) is being eagerly promoted which mounts an accumulator battery (hereinafter, referred to as "battery") and is capable of running by a motor driven by an electric power of the battery. As infrastructure development for such a vehicle, a charging device has been developed. With reference to FIG. **14**, an example of charging connectors at a charging device side will be described.

As illustrated in FIG. **14**, a charging connector **100** includes a connector case **110** storing a connector fitting portion **111** fitting into a vehicle-side inlet (not shown), a plurality of swinging members **120**A, **120**B formed with protruding claws **121**A, **121**B at a tip end of the charging connector **100** and locking pieces **122**A, **122**B at a backend thereof, and a release lever **130** having locking surfaces **131**, **132** on which locking pieces **122**A, **122**B are locked together, respectively.

The swinging members **120**A, **120**B are urged by a spring **123**B (the other spring is not shown) in a locking direction of the locking pieces **122**A, **122**B on the locking surfaces **131**, **132**, respectively. Further, the release lever **130** is urged by a spring **133** to a start position side of a push-in operation.

When such a charging connector **100** is inserted into the vehicle-side inlet, the protruding claw **121**A of one swinging member **120**A comes into contact with an inner circumferential surface of the vehicle-side inlet to be pushed into a notch (not shown) formed on an outer circumferential surface of the connector fitting portion **111**. When the charging connector **100** is inserted most inside the vehicle-side inlet (i.e., becomes in a completely fitted state), the protruding claw **121**A of the one swinging member **120**A protrudes from the notch (not shown) of the connector fitting portion **111** to be locked into a recessed portion (not shown) provided on the inner circumferential surface of the vehicle-side inlet, so that the charging connector **100** is locked to the vehicle-side inlet. At this point, the protruding claw **121**B of the other swinging member **120**B abuts on a tip end surface of the vehicle-side inlet to be pushed into the notch (not shown) of the connector fitting portion **111**, and then detects the completely fitted state of the charging connector **100**.

On the other hand, when the charging connector **100** is removed from the vehicle-side inlet after power is supplied to the battery, the release lever **130** is operated to be pushed in and, first, a tip end portion **134** of the release lever **130** abuts on one locking piece **122**A to push up the one swinging member **120**A. With this arrangement, the protruding claws **121**A, **121**B of the swinging members **120**A, **120**B respectively are pushed into the notch of the connector fitting portion **111** (not shown), so that the charging connector **100** can be removed from the vehicle-side inlet. At this point, since the locking pieces **122**A, **122**B are locked on the locking surfaces **131**, **132** respectively, the release lever **130** is blocked from moving to the start position side of the push-in operation.

SUMMARY OF THE INVENTION

However, according to a conventional charging connector **100** described above, during the push-in operation of the release lever **130**, when the locking pieces **122**A, **122**B are locked on locking surfaces **131**, **132** respectively, interference sound (collision sound) is generated when they are locked together (i.e., the sound is generated two times).

At this point, the interference sound generated first may cause an operator to stop the push-in operation of the release lever **130**, since he may have misconception that the push-in operation of the release lever **130** has been completed. In this case, the connector fitting portion **111** may not be able to be removed from the vehicle-side inlet, and thus a problem (e.g., damage of one claw portion **121**A) may occur caused by forcibly pulling out the connector fitting portion **111** from the vehicle-side inlet.

An object of the present invention is to provide the charging connector that can reduce the interference sound of the locking portion of the swinging member that is first locked on the locking surface of the release lever so as to prevent the push-in operation of the release lever from being stopped.

An aspect of the present invention is a charging connector including a release lever configured to move between a start position and a completion position of a push-in operation and be urged to a side of the start position, and having a locking groove portion including a locking surface that falls from a plane surface along a movement direction and a bottom surface; a lever holding arm swingably provided between a lever holding position where the release lever is held at the completion position and a lever non-holding position, and configured to be urged by a first urging unit in a locking direction of a first locking portion locked on the locking surface; and a locking auxiliary arm swingably provided between a locking position and a non-locking position on the locking surface, and configured to be urged by a second urging unit in a locking direction of a second locking portion locked on the locking surface, wherein the locking groove portion is set to have a depth in which each tip end of the first locking portion and the second locking portion and the bottom surface do not come into contact with each other; wherein at least one of the locking surface and the second locking portion includes an inclined surface having an angle of less than 90 degrees with respect to the plane surface; wherein, in a movement process of the release lever from the start position to the completion position, the first locking portion moves on the plane surface with an urging force of the first urging unit, and also the second locking portion slides over a top point between the plane surface and the inclined surface with an urging force of the second urging unit; and wherein, at the completion position of the release lever, the first locking portion falls from the plane surface to the locking groove portion with the urging force of the first urging unit to be locked on the locking surface, and the tip end of the first locking portion does not come into contact with the bottom surface.

The locking auxiliary arm may constitute a lock arm together with a lock main arm. The lock main arm is swingably provided between a locking position and a non-locking position with a vehicle-side inlet, and may have an engagement portion locked in the locking groove portion of the release lever at the non-locking position. In a movement

process of the release lever from the start position to the completion position, the lock main arm may be located at the locking position. At the completion position of the release lever, the lock main arm may be located at the non-locking position, and also the engagement portion may be locked on the locking surface.

The release lever may have an abutment portion where the release lever abuts on the lock main arm to swing the lock main arm to the non-locking position. The abutment portion may be formed in a curved shape.

According to the present invention, in a movement process of a release lever from a start position to a completion position, a second locking portion comes into contact with only a top point between a plane surface and an inclined surface. Thus, a surface of an inner wall of the second locking portion does not come into contact with a locking surface of the release lever. Therefore, interference sound of the second locking portion against the locking surface can be reduced. On the other hand, at the completion position of the release lever, a first locking portion falls from a plane surface to a locking groove portion to be locked on the locking surface, and thus a surface of the inner wall of the first locking portion comes into contact with the locking surface of the release lever. Therefore, the interference sound of the first locking portion against the locking surface is generated, and an operator can determine that the release lever has moved to the completion position. As described above, the interference sound of the second locking portion to be first locked on the locking surface of the release lever is reduced to prevent the push-in operation of the release lever from being stopped. Therefore, the problem caused by forcibly pulling out a connector fitting portion from the vehicle-side inlet can be prevented.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a total perspective view illustrating a charging connector according to an embodiment of the present invention.

FIG. **2** is a longitudinal cross-sectional view illustrating the charging connector according to the embodiment of the present invention.

FIG. **3** is a perspective view illustrating an inside of the charging connector according to the embodiment of the present invention.

FIG. **4** is a perspective view illustrating the inside of the charging connector according to the embodiment of the present invention.

FIG. **5** is a perspective view illustrating the inside of the charging connector according to the embodiment of the present invention.

FIG. **6** illustrates an action (before an inserting operation) of the charging connector according to the embodiment of the present invention.

FIG. **7** illustrates an action (in a middle of the inserting operation) of the charging connector according to the embodiment of the present invention.

FIG. **8** illustrates the action (in the middle of the inserting operation) of the charging connector according to the embodiment of the present invention.

FIG. **9** illustrates an action (completely fitted) of the charging connector according to the embodiment of the present invention.

FIG. **10**A to FIG. **10**C illustrate actions (starting a pulling operation) of the charging connector according to the embodiment of the present invention.

FIG. **11**A to FIG. **11**C illustrate actions (starting the pulling operation) of the charging connector according to the embodiment of the present invention.

FIG. **12** illustrates an action (in a middle of the pulling operation) of the charging connector according to the embodiment of the present invention.

FIG. **13** illustrates the action (in the middle of the pulling operation) of the charging connector according to the embodiment of the present invention.

FIG. **14** is a perspective view illustrating the inside of a charging connector according to background art.

DESCRIPTION OF THE EMBODIMENTS

Subsequently, with reference to figures, embodiments of the charging connector of the present invention will be described. For descriptions with reference to the figures below, a same or similar reference numeral is applied to a same or similar part. However, the figures are schematically drawn, and thus it should be noted that ratios of dimensions are not actual ratios. Therefore, specific dimensions should be determined in consideration of the descriptions below. Further, relationships and ratios of dimensions among the figures can include the different relationships and ratios from the actual ones.

Configuration of Charging Connector

First, with reference to figures, a configuration of a charging connector **1** according to the present embodiment will be described. FIGS. **1** to **5** illustrate the charging connector **1** according to the present embodiment.

For convenience of descriptions, a vehicle-side inlet **90** side of the charging connector **1** (left side of FIGS. **1** to **3**, and right side of FIG. **4**) is defined as a "tip end side", and a direction toward the tip end side is defined as a "fitting direction FD". Further, an opposite side of the vehicle-side inlet **90** side of the charging connector **1** (right side of FIGS. **1** to **3**, and left side of FIG. **4**) is defined as a "backend side", and a direction toward the backend side is defined as a "separation direction SD".

As illustrated in FIGS. **1** to **4**, the charging connector **1** is fitted into the vehicle-side inlet **90** (refer to FIG. **2**) including a reception-side terminal (not shown), and is used to supply the power to the battery of the vehicle. The charging connector **1** is mounted on a leading end of wire W (not shown) extended from a power source supply device (not shown).

The charging connector **1** includes connector cases **3**A, **3**B serving as two separated bodies in substantially mirror-image symmetry in which their end surfaces are combined with each other. The connector cases **3**A, **3**B include a case main body portion **5** and a handle portion **7** that inclines from back of the case main body portion **5** to be gripped by the operator. In front of the case main body portion **5**, a connector fitting portion **10** fitting into the vehicle-side inlet **90** is provided.

An outer circumferential surface of the connector fitting portion **10** is formed with a notch **11**. Inside the connector fitting portion **10**, a supply-side terminal (not shown) to be connected to the reception-side terminal (not shown) in the vehicle-side inlet **90** is stored. Arrangement of the supply-side terminals (not shown) is based on each specification, and it is not described herein.

At a lower side in the case main body portion **5**, the wire W extended from the connector fitting portion **10** is arranged, and the wire W passes through in the handle portion **7** to be drawn outside. At an upper side in the case main body portion

5, a lock arm **20**, a fitting detection arm **30**, a release lever **40**, and a lever holding arm **50** are provided.

Lock Arm

The lock arm **20** blocks the charging connector **1** from being separated from the vehicle-side inlet **90** in a state where the vehicle-side inlet **90** is fitted with the connector fitting portion **10**. As illustrated in FIGS. **2** to **4**, the lock arm **20** includes a locking main arm **21** swingably provided in the case main body portion **5** and a locking auxiliary arm **26** swinging with the locking main arm **21**.

The locking main arm **21**, as illustrated in FIGS. **1** to **3**, includes a locking claw **22** that is provided at a tip end side of the locking main arm **21** and can protrude from the notch **11** of the connector fitting portion **10**, and a locking engagement piece **23** that is provided at a backend of the locking main arm **21** and serves as the engagement portion latching in a lower-side locking groove portion **46** described below of the release lever **40**.

The locking main arm **21** is swingably provided about an axis core **24** between the locking position where the locking claw **22** is locked in a locking groove portion **91** (refer to FIG. **2**) provided on the inner circumferential surface of the vehicle-side inlet **90**, and the non-locking position where locking between the locking claw **22** and the locking groove portion **91** is released. The locking main arm **21** is urged toward a direction (upward direction TD) in which the locking claw **22** protrudes from the notch **11** of the connector fitting portion **10** by the coil spring **25**.

The locking main arm **21** is bent toward a downward direction BD close to the release lever **40**. The locking main arm **21** extends from a bent lower end along the separation direction SD, and a locking engagement piece **23** is provided at the tip end of the locking main arm **21**.

The locking engagement piece **23** engages with the lower-side locking groove portion **46** described below of the release lever **40** at the non-locking position of the locking main arm **21** (i.e., in a state where the locking claw **22** is saved in the notch **11**). On the other hand, engagement between the locking engagement piece **23** and the upper-side locking groove portion **45** described below of the release lever **40** is released at the locking position of the locking main arm **21** (i.e., in a state where the locking claw **22** protrudes from the notch **11**).

The locking auxiliary arm **26**, as illustrated in FIGS. **2** and **3**, includes an auxiliary locking piece **27** that is provided at a backend of the locking auxiliary arm **26**, and serves as the second locking portion locked in an upper-side locking groove portion **45** described below of the release lever **40**.

The locking auxiliary arm **26** is swingably provided about the axis core **26**A between the locking position where the auxiliary locking piece **27** is locked in the upper-side locking groove portion **45** described below of the release lever **40**, and the non-locking position (release position) where locking between the auxiliary locking piece **27** and the upper-side locking groove portion **45** is released. The locking auxiliary arm **26** is urged in a locking direction (downward direction BD) of the auxiliary locking piece **27** by the coil spring **28** serving as a second urging unit.

The auxiliary locking piece **27** extends toward the downward direction BD, and is provided capable of being locked in the upper-side locking groove portion **45** described below of the release lever **40**. The auxiliary locking piece **27** is provided at a position facing the locking engagement piece **23** described above. The auxiliary locking piece **27** is provided closer to the separation direction SD side than a detection locking piece **32** described below of the fitting detection arm **30** and the holding locking piece **51** described below of the lever holding arm **50**.

The auxiliary locking piece **27** is released from locking with the upper-side locking groove portion **45** described below of the release lever **40** at the non-locking position of the locking main arm **21** (i.e., in a state where the locking claw **22** is saved in the notch **11**). On the other hand, the auxiliary locking piece **27** can be locked with the upper-side locking groove portion **45** described below of the release lever **40** at the locking position with the locking main arm **21** (i.e., in a state where the locking claw **22** protrudes from the notch **11**).

Fitting Detection Arm

A fitting detection arm **30** detects a completely fitted state between the vehicle-side inlet **90** and the connector fitting portion **10**. The fitting detection arm **30**, as illustrated in FIGS. **2** to **4**, includes a detection claw **31** that is provided at a tip end side of the fitting detection arm **30** and is capable of protruding from the notch **11** of the connector fitting portion **10**, and the detection locking piece **32** that is provided at a backend side of the fitting detection arm **30** and locked in the upper-side locking groove portion **45** described below of the release lever **40**.

The fitting detection arm **30** is swingably provided about an axis core **33** between a fitting position where the detection claw **31** comes into contact with the tip end surface of the vehicle-side inlet **90** to detect fitting of the connector fitting portion **10** into the vehicle-side inlet **90**, and the separation position where contact between the detection claw **31** and the vehicle-side inlet **90** is released to detect separation of the connector fitting portion **10** from the vehicle-side inlet **90**. The fitting detection arm **30** is urged by the coil spring **34** toward a direction in which the detection claw **31** protrudes to the notch **11** of the connector fitting portion **10** (i.e., locking direction of the detection locking piece **32**).

The detection claw **31** is provided capable of going outside and coming back from the notch **11** of the connector fitting portion **10** (capable of forwarding or withdrawing). The detection claw **31** is provided closer to the separation direction SD side than the locking claw **22** of the locking main arm **21** described above.

The detection locking piece **32** extends toward the downward direction BD, and is provided capable of being locked in the upper-side locking groove portion **45** described below of the release lever **40**. The detection locking piece **32** is provided closer to a fitting direction FD side than the auxiliary locking piece **27** of the locking auxiliary arm **26**, and is provided closer to the separation direction SD side than the holding locking piece **51** described below of the lever holding arm **50**.

The detection locking piece **32** is released from locking in the upper-side locking groove portion **45** described below of the release lever **40** at the fitting position of the connector fitting portion **10** (i.e., in a state where the detection claw **31** is saved in the notch **11** of the connector fitting portion **10**). On the other hand, the detection locking piece **32** is locked in the upper-side locking groove portion **45** described below of the release lever **40** at the separation position of the connector fitting portion **10** (i.e., in a state the detection claw **31** protrudes from the notch **11** of the connector fitting portion **10**).

Between the detection locking piece **32** and the axis core **33**, a protrusion **35** (refer to FIGS. **2** and **3**) protruding toward the downward direction BD is provided. The protrusion **35** releases locking between the upper-side locking groove portion **45** described below of the release lever **40** and the holding

locking piece **51** described below of the lever holding arm **50** by pressing the tip end side of the lever holding arm **50** (closer to the tip end side than the axis core **52** described below) toward the downward direction BD.

Release Lever

The release lever **40** slides to move toward the fitting direction FD and the separation direction SD to release locking between the locking groove portion **91** inside the vehicle-side inlet **90** and the locking claw **22**. The release lever **40** moves from the start position to the completion position of the push-in operation.

The release lever **40**, as illustrated in FIGS. **2** and **3**, includes a release switch **41** whose backend protrudes from the case main body portion **5** and that moves in a fitting and separation direction FSD, and a release main body portion **42** provided in the case main body portion **5** and integrally formed with the release switch **41**.

The release switch **41** is urged to the start position of the push-in operation (i.e., at the separation direction SD side) by the coil spring **43**. The release main body portion **42** includes a tip-end abutment portion **44** that abuts on and pushes up the auxiliary locking piece **27** of the locking auxiliary arm **26**, the detection locking piece **32** of the fitting detection arm **30**, and the holding locking piece **51** described below of the lever holding arm **50** when the push-in operation of the release switch **41** is performed.

The tip-end abutment portion **44** abuts on the inclined surface **21**A of the locking main arm **21** at the completion position of the push-in operation of the release switch **41** to swing the locking main arm **21** to the non-locking position. The tip-end abutment portion **44** is formed in a curved shape.

At the tip end upper side of the release main body portion **42**, the upper-side locking groove portion **45** is provided in which the auxiliary locking piece **27** of the locking auxiliary arm **26** and the detection locking piece **32** of the fitting detection arm **30** are locked. On the other hand, at the tip end lower side of the release main body portion **42**, the lower-side locking groove portion **46** in which the locking engagement piece **23** of the locking main arm **21** is locked is provided.

More specifically, as illustrated in FIG. **5**, the upper-side locking groove portion **45** includes a locking surface **45**A falling from a plane surface **47** along a movement direction of the release main body portion **42** and a bottom surface **45**B along a back direction from the lower end of the locking surface **45**A. The upper-side locking groove portion **45** is set to have a depth in which each tip end of the auxiliary locking piece **27**, the detection locking piece **32**, and the holding locking piece **51** described below do not come into contact with the bottom surface **45**B (refer to FIG. **11**C).

On the locking surface **45**A, the auxiliary locking piece **27**, the detection locking piece **32**, and the holding locking piece **51** described below are locked. At one part of the locking surface **45**A (part corresponding to the auxiliary locking piece **27**), an inclined surface **45**D having an "α" angle of less than 90 degrees with respect to the plane surface **47** is provided.

The top point **45**E between the plane surface **47** and the inclined surface **45**D is configured to come into contact with an inner wall **27**A of the auxiliary locking piece **27** in the movement process of the release lever **40** from the start position to the completion position. In other words, the inner wall **27**A of the auxiliary locking piece **27** is configured to slide over the top point **45**E (so called an "edge") between the plane surface **47** and the inclined surface **45**D, and a surface of the inner wall **27**A of the auxiliary locking piece **27** is configured not to come into contact with the locking surface **45**A in the movement process of the release lever **40** from the start position to the completion position.

Lever Holding Arm

The lever holding arm **50** holds the release lever **40** at the completion position of the release lever **40**. The lever holding arm **50** includes, as illustrated in FIGS. **2** to **4**, the holding locking piece **51** that is provided at a backend side of the lever holding arm **50** and serves as the first locking portion locking in the upper-side locking groove portion **45** of the release lever **40** at a pressing position of the release lever **40**.

The lever holding arm **50** is swingably provided about the axis core **52** between a lever holding position where the release lever **40** is held at the completion position (i.e., a state where the holding locking piece **51** is locked in the upper-side locking groove portion **45**), and a lever non-holding position where the release lever **40** is not held (i.e., a state where locking between the holding locking piece **51** and the upper-side locking groove portion **45** is released).

At the holding locking piece **51** side from the axis core **33** of the lever holding arm **50**, the coil spring **53** serving as the first locking portion is provided to urge the holding locking piece **51** side to forward in the downward direction BD by the coil spring **28**. At the tip end side from the axis core **33** of the lever holding arm **50**, the fitting detection arm **30** can abut on the protrusion **35**.

The holding locking piece **51** extends toward the downward direction BD, and is provided capable of being locked in the upper-side locking groove portion **45** of the release lever **40**. The holding locking piece **51** is provided closer to the fitting direction FD side than the auxiliary locking piece **27** of the locking auxiliary arm **26** and the detection locking piece **32** of the fitting detection arm **30**.

The holding locking piece **51** is locked in the upper-side locking groove portion **45** of the release lever **40** at the lever holding position. On the other hand, at the lever non-holding position, the holding locking piece **51** at the tip end side from the axis core **33** of the lever holding arm **50** is pressed by the protrusion **35** so that the locking between the upper-side locking groove portion **45** of the release lever **40** and the holding locking piece **51** is released.

Action of Charging Connector

Subsequently, with reference to the figures, actions of the above-described charging connector **1** will be described. FIGS. **6** to **13** illustrate actions of the charging connector **1** according to the present embodiment.

Insertion Operation

As illustrated in FIG. **6**, in the separation state of the charging connector **1** from the vehicle-side inlet **90**, the locking claw **22** of the locking main arm **21** and the detection claw **31** of the fitting detection arm **30** protrude from the notch **11** of the connector fitting portion **10**.

At this point, the detection locking piece **32** of the fitting detection arm **30** is locked in the upper-side locking groove portion **45** of the release lever **40**. Further, since the auxiliary locking piece **27** is located closer to the separation direction SD side than the detection locking piece **32**, the auxiliary locking piece **27** is ready for being instantly locked when locking between the detection locking piece **32** and the upper-side locking groove portion **45** is released in a state where the

auxiliary locking piece **27** is not completely locked in the upper-side locking groove portion **45**.

Subsequently, as illustrated in FIG. **7**, if the charging connector **1** is gradually fitted into the vehicle-side inlet **90**, the charging connector **1** abuts on the inner circumferential surface of the vehicle-side inlet **90** so that the locking claw **22** is saved in the notch **11** of the connector fitting portion **10** (pushed in). Then, the locking main arm **21** swings to remove the auxiliary locking piece **27** from the upper-side locking groove portion **45**. At this point, the locking engagement piece **23** of the locking main arm **21** is inserted into the lower-side locking groove portion **46**.

Subsequently, as illustrated in FIG. **8**, if the charging connector **1** is further fitted into the vehicle-side inlet **90**, the charging connector **1** abuts on the tip end surface of the vehicle-side inlet **90** so that the detection claw **31** is saved in the notch **11** of the connector fitting portion **10** (pushed in). Then, the fitting detection arm **30** swings to remove the detection locking piece **32** from the upper-side locking groove portion **45**. At this point, since the locking engagement piece **23** is inserted into the lower-side locking groove portion **46** of the release main body portion **42**, the release lever **40** is still blocked from moving to the separation direction SD side (start position side of the push-in operation).

Subsequently, as illustrated in FIG. **9**, if the charging connector **1** is completely fitted into the vehicle-side inlet **90**, the locking main arm **21** swings, and the locking claw **22** protrudes from the notch **11** of the connector fitting portion **10** to locate the locking main arm **21** to a locking position. Then, the locking claw **22** is locked in the locking groove portion **91** of the vehicle-side inlet **90**. Further, since the locking engagement piece **23** is removed from the lower-side locking groove portion **46**, the release lever **40** moves to the separation direction SD side (start position side of the push-in operation).

Pulling-Out Operation

As illustrated in FIGS. **10** and **11**, when the charging to the battery (not shown) to be mounted to the vehicle is finished and a charging connector **100** is removed from the vehicle-side inlet **90**, the push-in operation (pressing to the fitting direction FD side) is performed on the release switch **41** of the release lever **40**.

At this point, the release lever **40** passes through the movement process illustrated in FIGS. **10**B and **10**C from the start position of the push-in operation illustrated in FIG. **10**A to the completion position of the push-in operation illustrated in FIG. **12**.

Herein, as illustrated in FIGS. **10**A and **11**A, at the start position of the push-in operation of the release lever **40**, the auxiliary locking piece **27** of the locking auxiliary arm **26**, the detection locking piece **32** of the fitting detection arm **30**, and the holding locking piece **51** of the lever holding arm **50** are held up by the tip-end abutment portion **44** of the release main body portion **42**.

First, in the movement process of the release lever **40** from the start position to the completion position (i.e., right before the completion position), when the release main body portion **42** moves toward the fitting direction FD, the auxiliary locking piece **27** and the holding locking piece **51** move toward the separation direction SD on the plane surface **47** with an urging force of the coil spring **28** as illustrated in FIGS. **10**A and **11**A. Then, as illustrated in FIGS. **10**B and **11**B, the auxiliary locking piece **27** located closer to the separation direction SD side than the holding locking piece **51** slides over the top point **45**E between the plane surface **47** and the inclined surface **45**D (in contact with only the top point **45**E), and falls in the upper-side locking groove portion **45** as illustrated in FIGS. **10**C and **11**C. At this point, the tip end of the auxiliary locking piece **27** does not come into contact with the bottom surface **45**B of the upper-side locking groove portion **45**. The locking main arm **21** is still located at the locking position.

Further, as illustrated in FIG. **12**, at the completion position of the release lever **40** that has moved toward the fitting direction FD, the tip-end abutment portion **44** of the release main body portion **42** abuts on the inclined surface **21**A of the locking main arm **21** to swing the locking main arm **21**. Then, the locking claw **22** is pushed into the notch **11** of the connector fitting portion **10** to locate the locking main arm **21** at the non-locking position.

The auxiliary locking piece **27** of the locking auxiliary arm **26** is pushed up from the upper-side locking groove portion **45** accordingly, and the locking engagement piece **23** is inserted into the lower-side locking groove portion **46**. In addition, the holding locking piece **51** of the lever holding arm **50** falls from the plane surface **47** to the upper-side locking groove portion **45** with the urging force of the coil spring **53** to be locked on the locking surface **45**A. At this point, the tip end of the holding locking piece **51** does not come into contact with the bottom surface **45**B of the upper-side locking groove portion **45**. The release lever **40** is held at the completion position of the push-in operation, and the release lever **40** is blocked from moving to the start position side of the push-in operation.

Subsequently, as illustrated in FIG. **13**, if the charging connector **100** is gradually separated away from the vehicle-side inlet **90**, the fitting detection arm **30** swings, and the detection claw **31** protrudes from the notch **11** of the connector fitting portion **10**. Then, the detection locking piece **32** is locked in the upper-side locking groove portion **45**. At this point, the protrusion **35** provided at a back surface side of the fitting detection arm **30** swings the lever holding arm **50**, and the holding locking piece **51** is removed from the upper-side locking groove portion **45**.

The charging connector **100** completely separates away from the vehicle-side inlet **90** to return to the state described above right before an insertion operation of the charging connector **100** has been performed (refer to FIG. **6**).

Operation, Effects

According to the present embodiment described above, in the movement process of the release lever **40** from the start position to the completion position, since the auxiliary locking piece **27** comes into contact with only the top point **45**E between the plane surface **47** and the inclined surface **45**D of the release lever **40**, the surface of the inner wall **27**A of the auxiliary locking piece **27** does not come into contact with the locking surface **45**A. Therefore, the interference sound of the auxiliary locking piece **27** against the locking surface **45**A can be reduced. On the other hand, at the completion position of the release lever **40**, the holding locking piece **51** falls from the plane surface **47** of the release lever **40** into the upper-side locking groove portion **45** to be locked on the locking surface **45**A, and the surface of the inner wall of the holding locking piece **51** comes into contact with the locking surface **45**A. Therefore, the interference sound of the holding locking piece **51** against the locking surface **45**A is generated so that the operator can determine that the release lever **40** has moved up to the completion position. As described above, the interference sound of the auxiliary locking piece **27** first locked on the locking surface **45**A of the release lever **40** can be reduced to prevent the push-in operation of the release lever **40** from

being stopped. Therefore, the problem (e.g., damage of the locking claw **22**) caused by forcibly pulling out the connector fitting portion **10** from the vehicle-side inlet **90** can be prevented.

According to the present embodiment, at the non-locking position of the locking main arm **21**, the auxiliary locking piece **27** of the locking auxiliary arm **26** is pushed up from the upper-side locking groove portion **45** so that the locking engagement piece **23** is inserted into the lower-side locking groove portion **46**. At this point, the holding locking piece **51** is locked on the locking surface **45**A. With this arrangement, even if the holding locking piece **51** is released to be locked on the locking surface **45**A by some causes (e.g., damage of the holding locking piece **51**), it can be realized that the locking engagement piece **23** is instantly locked in the lower-side locking groove portion **46** (i.e., double latch).

According to the present embodiment, the release main body portion **42** of the release lever **40** includes the curved tip-end abutment portion **44** and thus, when the push-in operation of the release switch **41** is performed, the interference sound generated against each member can be further reduced, for example, when the curved tip-end abutment portion **44** abuts on and pushes up the auxiliary locking piece **27**, the detection locking piece **32**, and the holding locking piece **51**, or when it abuts on the inclined surface **21**A of the locking main arm **21** to swing the locking main arm **21**.

According to the present embodiment, the auxiliary locking piece **27** is arranged closer to the separation direction SD side than the holding locking piece **51**, and the inclined surface **45**D is provided only in a region that is in contact with the auxiliary locking piece **27** of the locking surface **45**A. Therefore, only by processing a part of the upper-side locking groove portion **45** of the release lever **40**, the interference sound of the auxiliary locking piece **27** for first locking on the locking surface **45**A of the release lever **40** can be reduced.

Other Embodiment

As described above, the contents of the present invention have been disclosed via the embodiment of the present embodiment, but it should not be understood that the descriptions and the figures configuring a part of the disclosure limit the present invention. The disclosure clarifies various types of alternative forms, embodiments, and application techniques for those skilled in the art.

For example, the embodiment of the present invention can be changed as below. More specifically, the charging connector **1** has been described as being used for supplying the power to the battery of the vehicle, but the charging connector **1** should not be limited thereto. It can be also applied to inlets of charging devices mounted to ships, submarines, and airplanes when they move, and also inlets of charging devices provided in houses, buildings, and factories.

Further, the inclined surface **45**D has been described as being to be provided on a part of the locking surface **45**A (point corresponding to the auxiliary locking piece **27**), but the inclined surface **45**D is not limited thereto. It may be also provided at a point corresponding to the detection locking piece **32**.

Furthermore, the inclined surface **45**D has been described as being provided on the upper-side locking groove portion **45**, but it is not limited thereto. For example, the inclined surface **45**D may be provided at the auxiliary locking piece **27** side. In other words, the inclined surface **45**D is provided at least one of the auxiliary locking piece **27** and the inclined surfaces **45**D of the upper-side locking groove portion **45**, and it may also be provided at both. The inclined surface **45**D does not always need to be in a straight line shape, but may be in a curved line shape.

Moreover, the tip-end abutment portion **44** has been described as being formed in a curved shape, but it is not limited thereto. The tip-end abutment portion **44** may be formed in other shape (e.g., inclined surface).

As described above, the present invention, of course, includes various types of embodiments that are not described herein. Therefore, the technical scope of the present invention can be defined only by specific items of the invention according to the appropriate scope of the claims of the invention based on the above-described descriptions.

What is claimed is:

1. A charging connector comprising:

a release lever configured to move between a start position and a completion position of a push-in operation and be urged to a side of the start position, and having a locking groove portion including a locking surface that falls from a plane surface along a movement direction and a bottom surface;

a lever holding arm swingably provided between a lever holding position where the release lever is held at the completion position and a lever non-holding position, and configured to be urged by a first urging unit in a locking direction of a first locking portion locked on the locking surface; and

a locking auxiliary arm swingably provided between a locking position and a non-locking position on the locking surface, and configured to be urged by a second urging unit in a locking direction of a second locking portion locked on the locking surface,

wherein the locking groove portion is set to have a depth in which each tip end of the first locking portion and the second locking portion and the bottom surface do not come into contact with each other;

wherein at least one of the locking surface and the second locking portion includes an inclined surface having an angle of less than 90 degrees with respect to the plane surface;

wherein, in a movement process of the release lever from the start position to the completion position, the first locking portion moves on the plane surface with an urging force of the first urging unit, and also the second locking portion slides over a top point between the plane surface and the inclined surface with an urging force of the second urging unit; and

wherein, at the completion position of the release lever, the first locking portion falls from the plane surface to the locking groove portion with the urging force of the first urging unit to be locked on the locking surface, and the tip end of the first locking portion does not come into contact with the bottom surface.

2. The charging connector according to claim **1**,

wherein the locking auxiliary arm constitutes a lock arm together with a lock main arm;

wherein the lock main arm is swingably provided between a locking position and a non-locking position with a vehicle-side inlet, and has an engagement portion locked in the locking groove portion of the release lever at the non-locking position;

wherein, in a movement process of the release lever from the start position to the completion position, the lock main arm is located at the locking position; and

wherein, at the completion position of the release lever, the lock main arm is located at the non-locking position, and also the engagement portion is locked on the locking surface.

3. The charging connector according to claim **2**,

wherein the release lever has an abutment portion where the release lever abuts on the lock main arm to swing the lock main arm to the non-locking position, and

wherein the abutment portion is formed in a curved shape.

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